The Energy-Water Nexus: Managing Risk in the Arid Southwest

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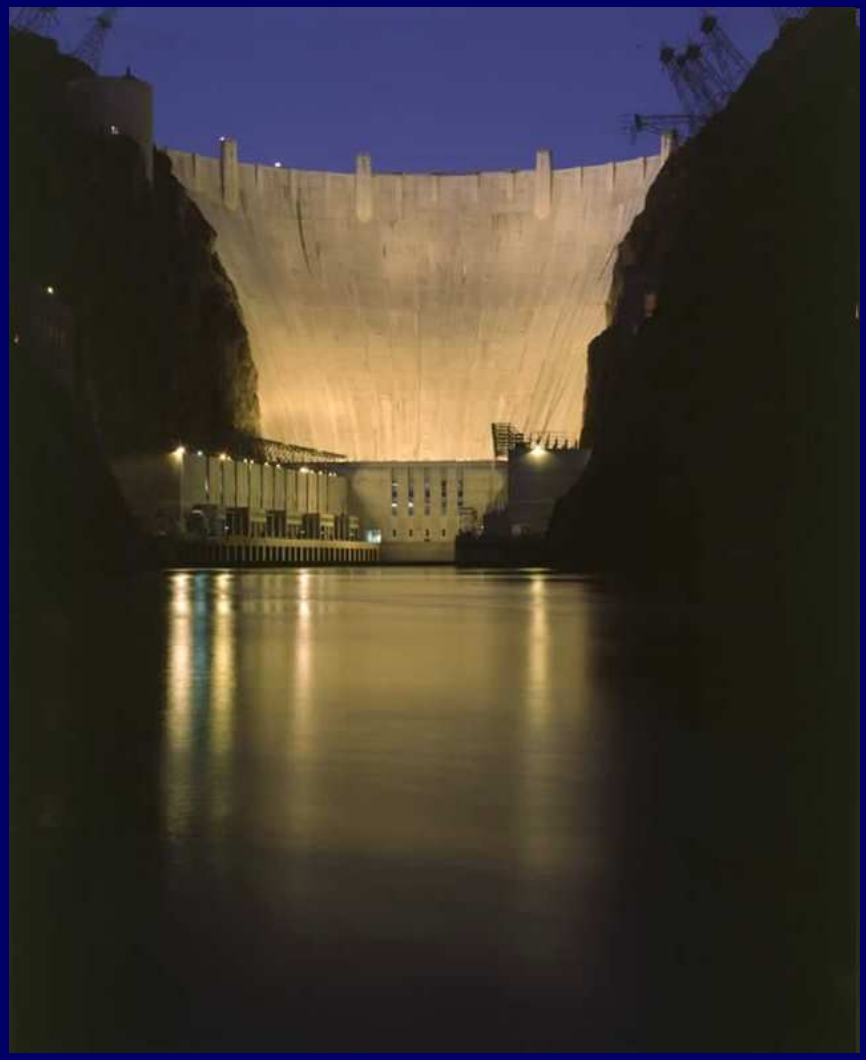
Outline

- Background
- Managing Energy-Water Issues
- Case Study: NGS & CAP

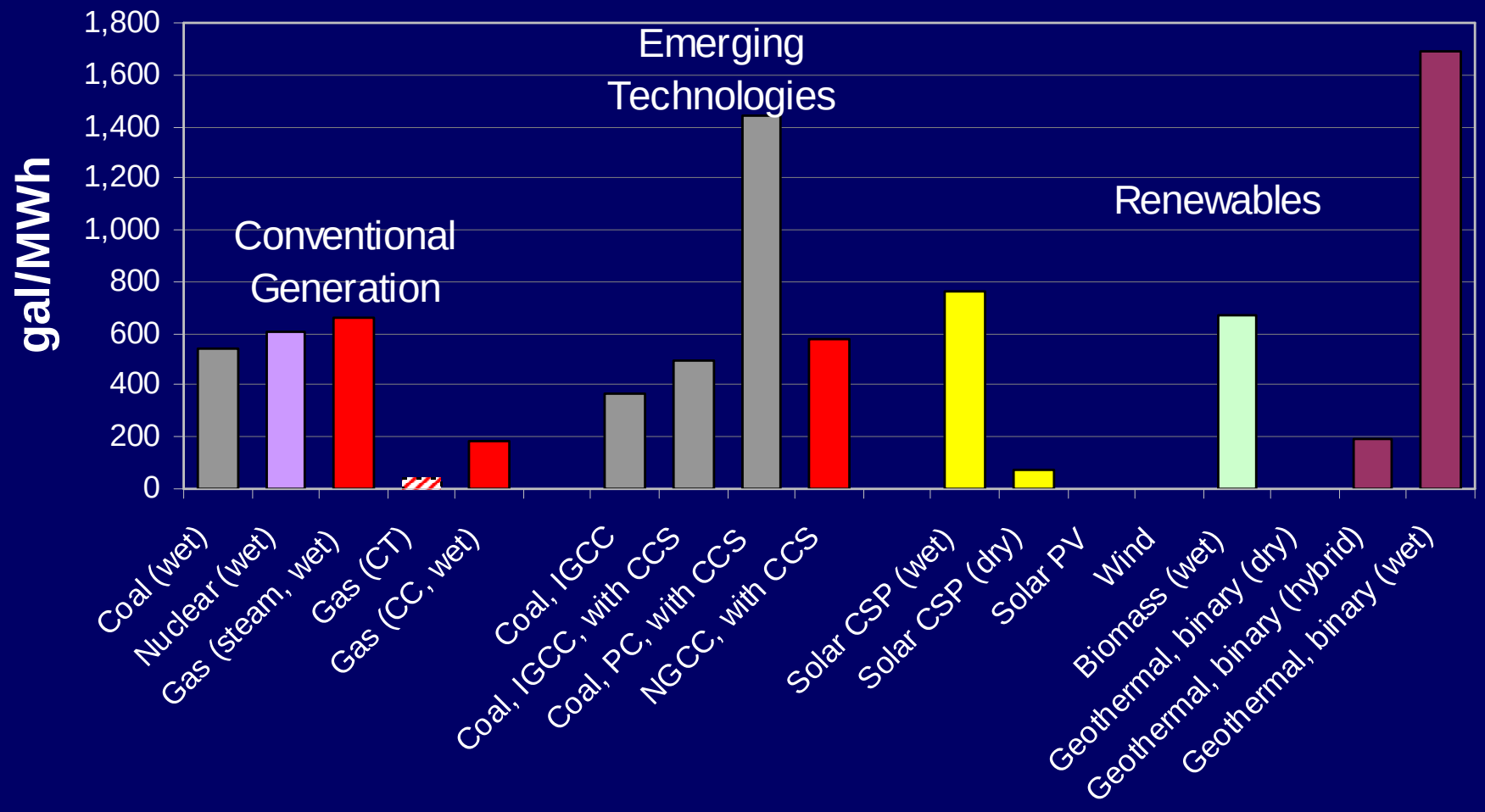


Background

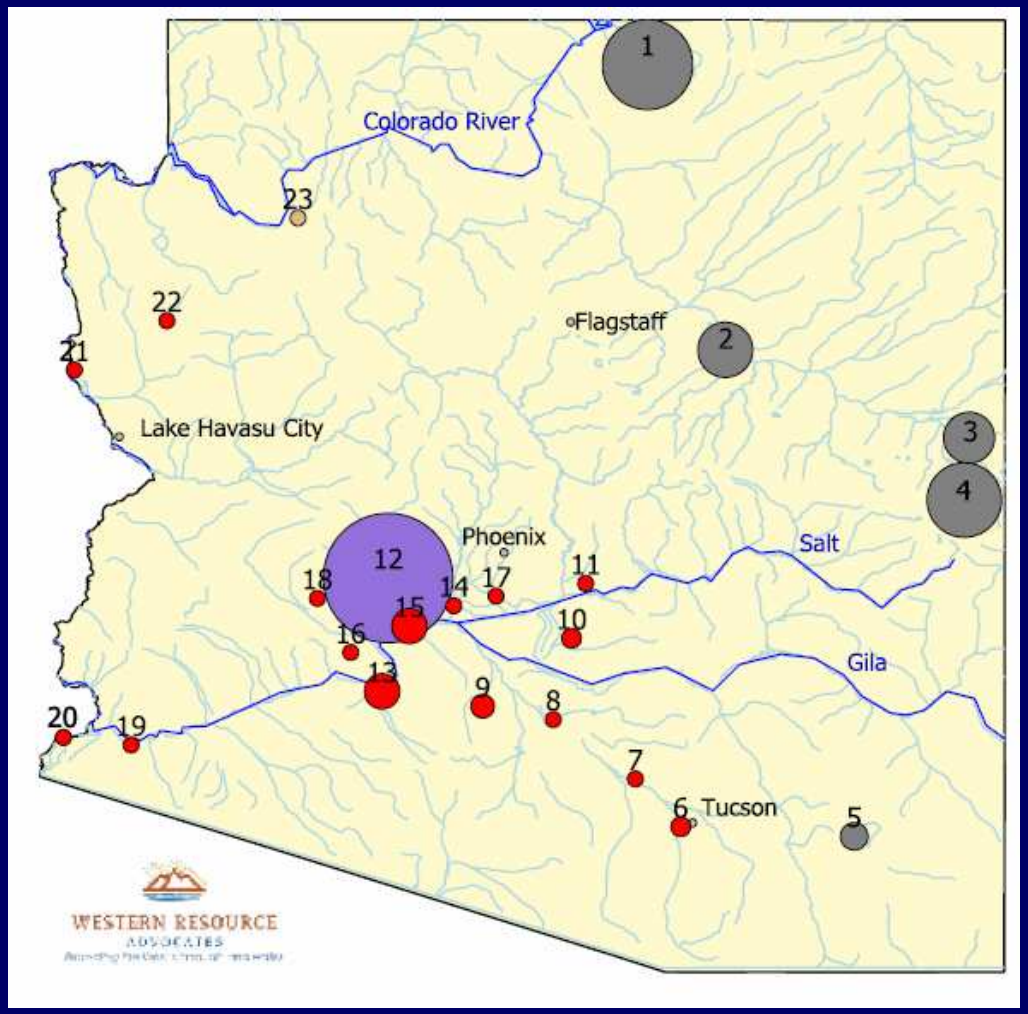
Thermoelectric power plants in Arizona, Colorado, New Mexico, Nevada, and Utah consumed an estimated 292 million gallons of water a day in 2005 – equal to the water consumed by Denver, Phoenix, and Albuquerque, combined.

Background

Water Intensity of Electricity



Background – Arizona Power Plants



Plant Name & Consumptive Water Use (AF/yr)		
1	Navajo	27,300
2	Cholla	11,800
3	Coronado	10,400
4	Springerville	18,500
5	Apache Station	3,600
6	Sundt	1,600
7	Saguaro	1
8	Desert Basin	900
9	Red Hawk	2,600
10	Santan	1,600
11	Ocotillo	100
12	Palo Verde	58,300
13	Gila	4,700
14	Agua Fria	40
15	Mesquite	6,400
16	Arlington Valley	1,000
17	West Phoenix	900
18	Harquahala	1,300
19	Yucca	700
20	Yuma	100
21	South Point	1,200
22	Griffith	1,000
23	Nelson	1

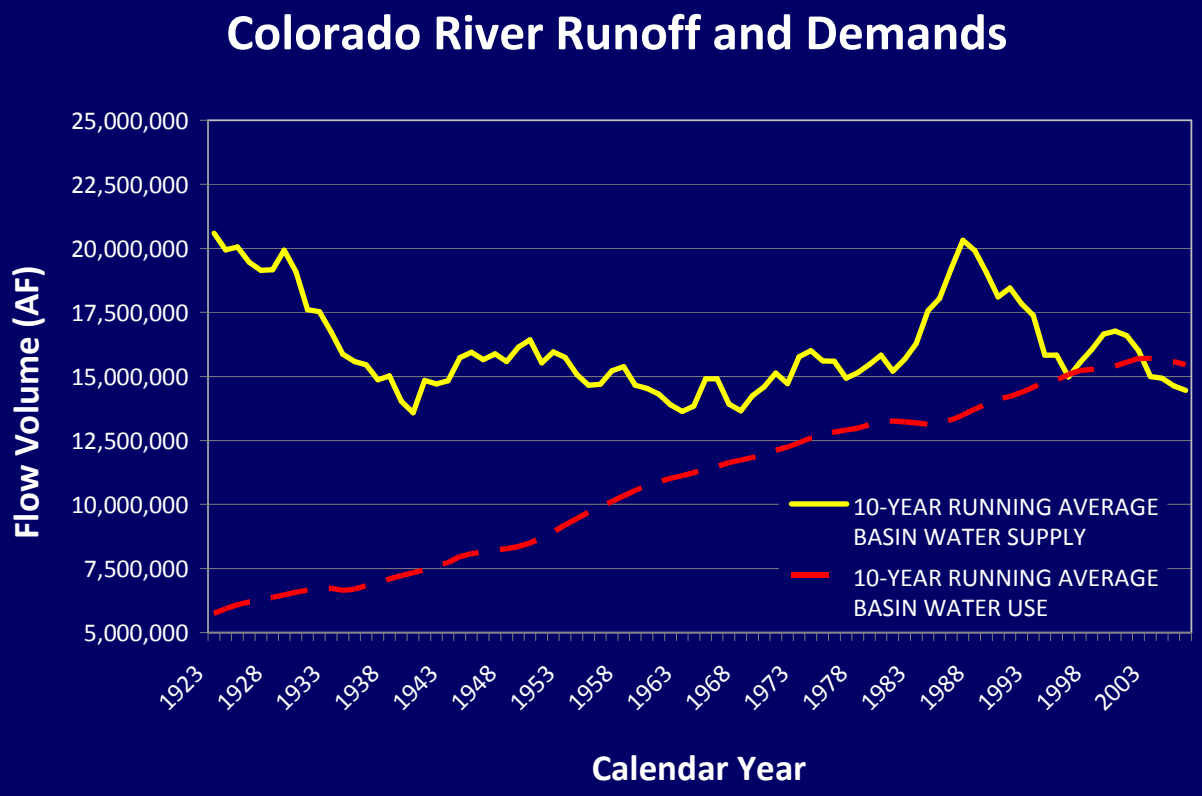
Coal Nuclear Natural Gas

* Draft

Background – Colorado River Basin

- Supplies = Demands
- At mid-century, 23 out of 24 climate models project decreases of 5 – 20% in runoff in the Upper Colorado.

zero sum game?



Source: Bureau of Reclamation

How do we manage water-related risks?

Critical Issues

- Competition for limited water supplies today and in future
- New power plant = commitment to use water for 40 – 50 yrs (or longer)

- What is the risk associated with locking in that water use?
- How do we manage that risk – and value the water used?

What Are the Effects of Drought?

1. Changes in plant operation

Coal Generation: Decreased
Gas Generation: Increased
Hydro Generation: Decreased
Renewable Generation: No change
Energy Not Served: Increased
Electricity Cost: Increased, especially in summer months (by as much as 30%)
CO_2 Emissions: Increased

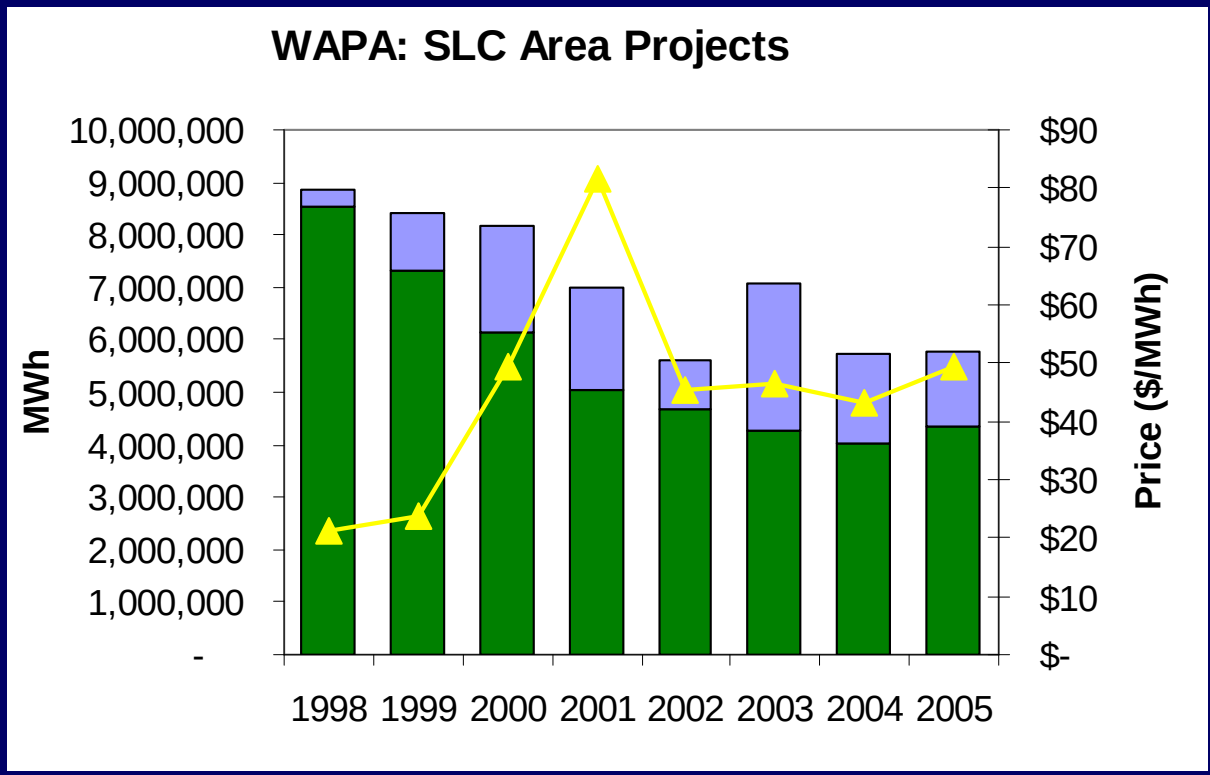
- *Actual* impacts will depend on water rights and other factors.
- *Long-term, technology choices can act as a hedge against drought*

NETL: *An Analysis of the Effects of Drought Conditions on Electric Power Generation in the Western United States, 2009.*

What Are the Effects of Drought?

2. Reduce hydroelectric generation.

   – May lead to more power purchases, with potentially higher costs for market purchases and greenhouse gas emissions.



What Are the Effects of Drought?

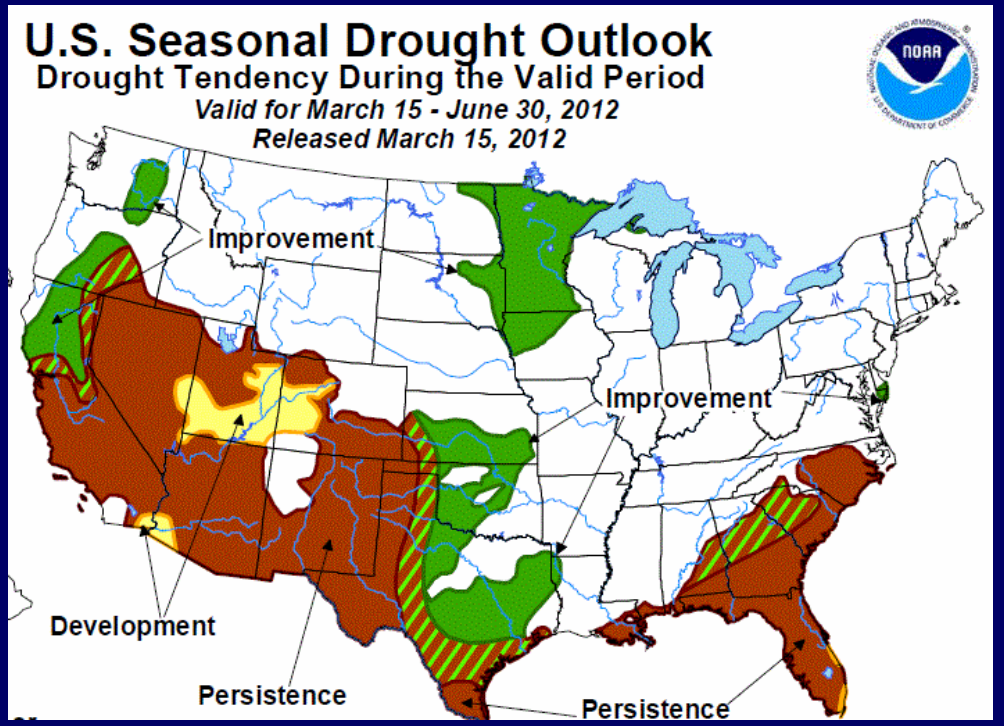
3. Power plants purchase/lease water from other users.
   - Ex: Laramie River Station, Wyoming
   - Cooling reservoir at ~10% in January, 2008
   - Basin Electric actions: purchase agricultural water and convey via 90,000 ft. pipeline; agricultural water required additional treatment

What Are the Effects of Drought?

- Ex: Texas, 2011 – 2012
- *"If we don't get any rain between now and next summer, there's potentially several thousand megawatts of generation that wouldn't be available and would be affected."*

  Kent Saathoff, ERCOT (The Texas Tribune, September 16, 2011. "Drought Could Pose Problems for Texas Power Plants")

- Lower Colorado River Authority (TX)
- No water for agricultural operations in 2012; water preserved for municipal and industrial uses (with restrictions)



http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html

How Can We Manage Risk?

1. Include information in utility analyses and resource filings
   - Resource plans, SARAs
2. Value water (and other externalities)
   - Current value and future value (opportunity cost?)
3. Recognize the risk of drought, and the value of water-efficient resources as a hedge

Managing Risk - Information

- Arizona
  - APS - began reporting water use and water intensity in 2009
  - Will develop a methodology for valuing externalities, including water
  - Water has played a role in past siting decisions

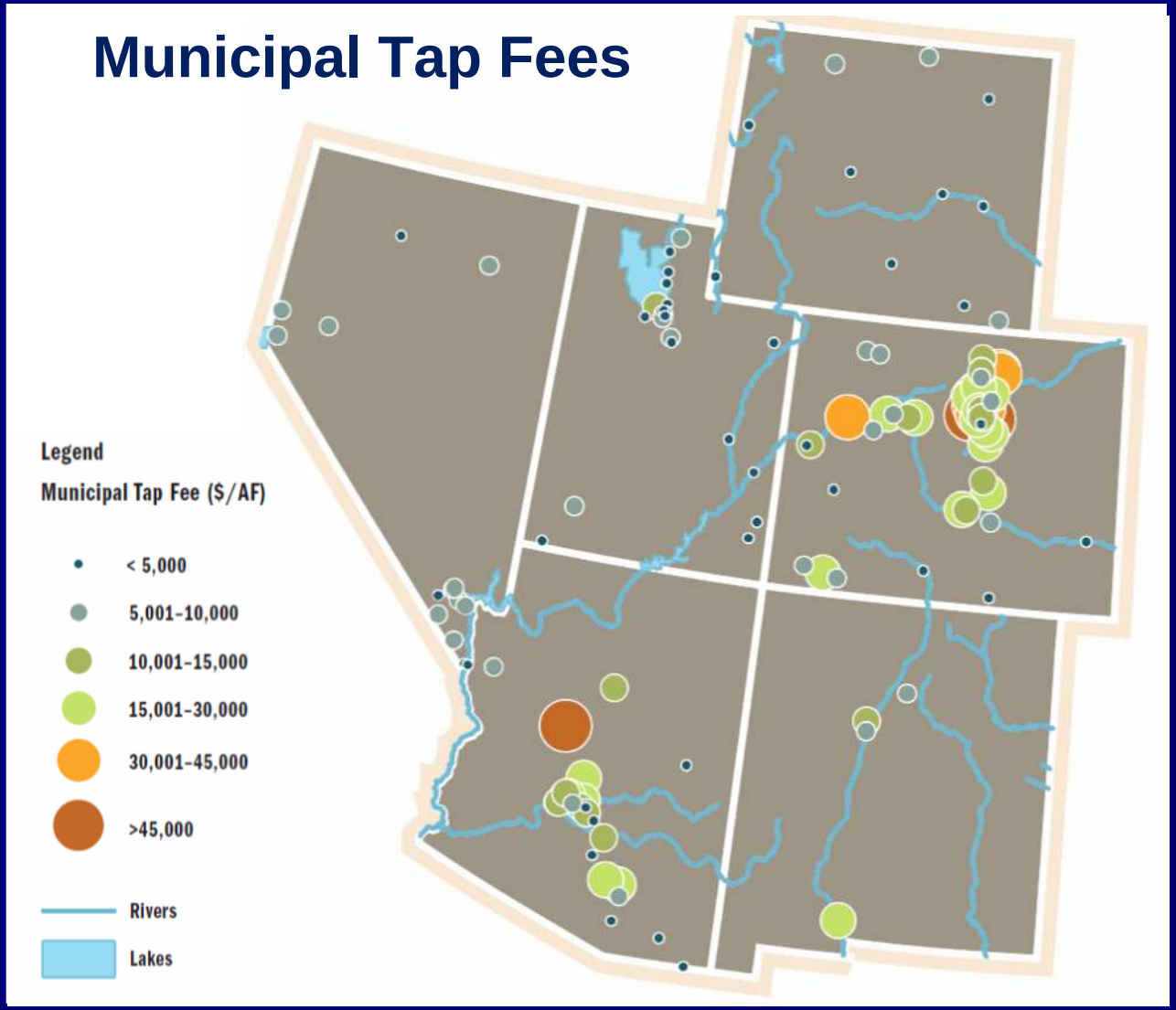
- Colorado
  - Utilities must report water use and water intensity (2011)
  - Water (and value of water) was a factor in the 2010 Clean Air-Clean Jobs hearings at the PUC

Managing Risk - Valuing Water

Depends on:

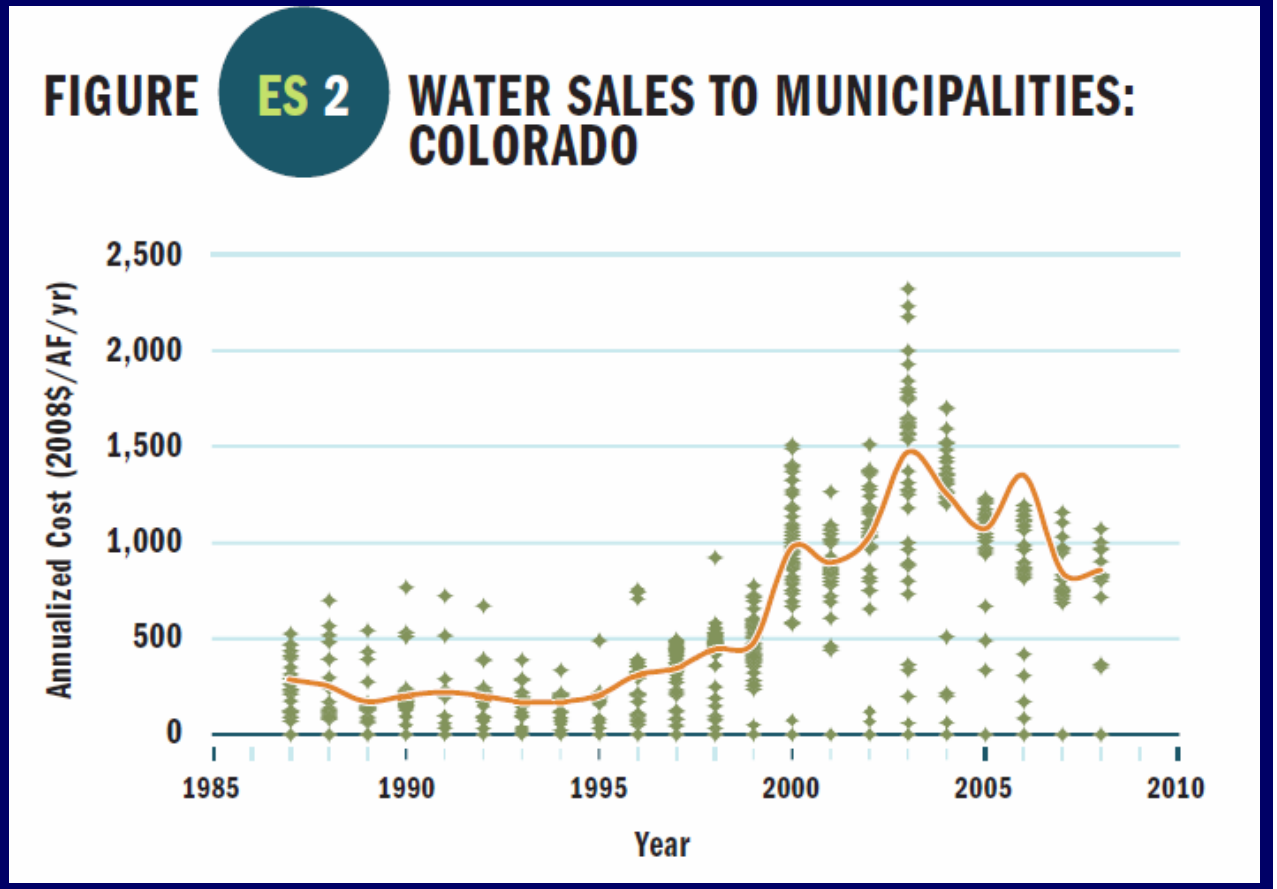
- *Use*
- *Location*
- *Scarcity*

Costs are not annualized, but are adjusted to a common metric ($/AF)



Managing Risk - Valuing Water

- *Value/price changes with time*



Managing Risk – Next Steps

- How do water-efficient energy supplies act as a hedge against drought?

Case Study: Navajo Generating Station and the Central Arizona Project

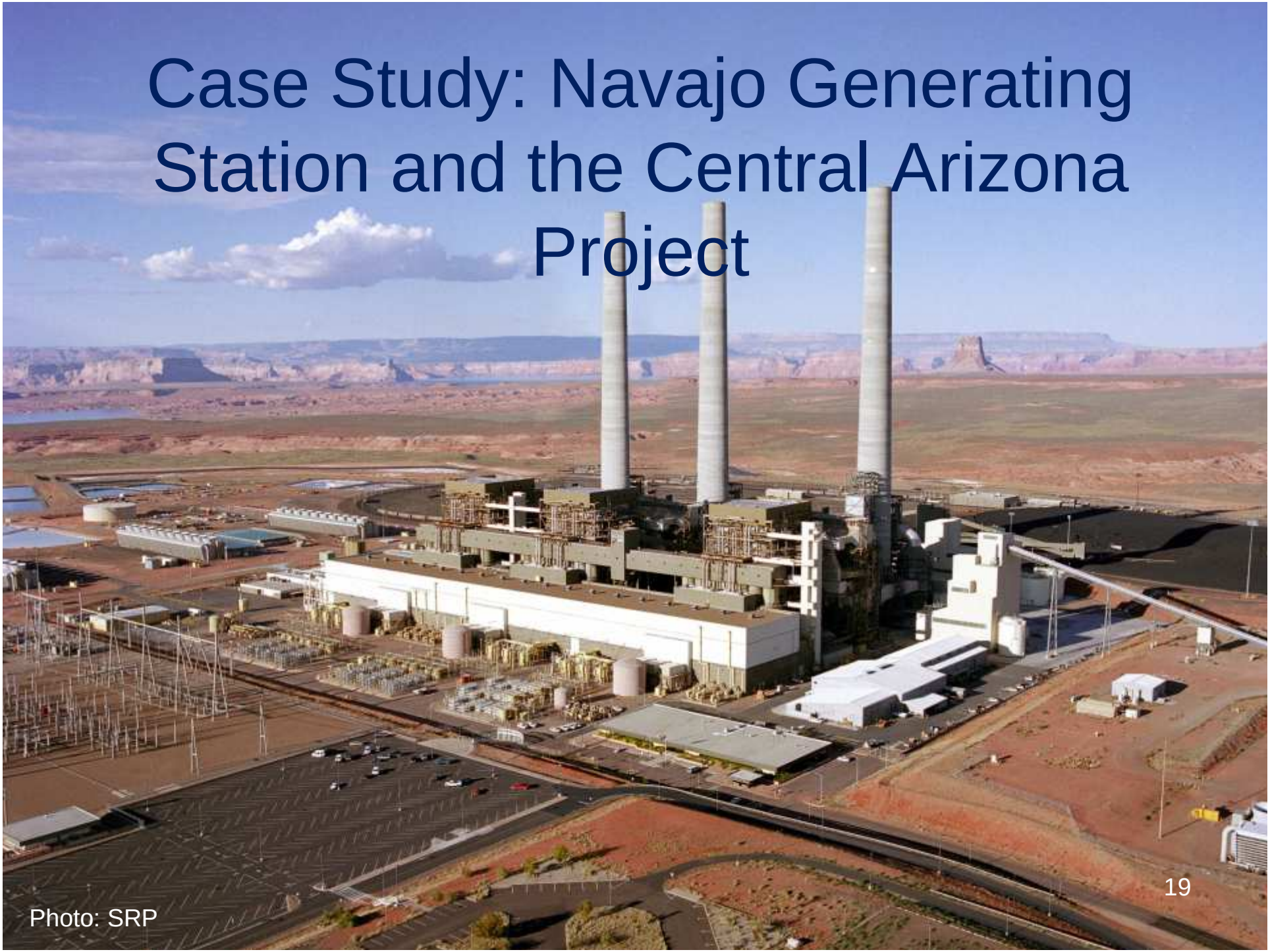


Photo: SRP

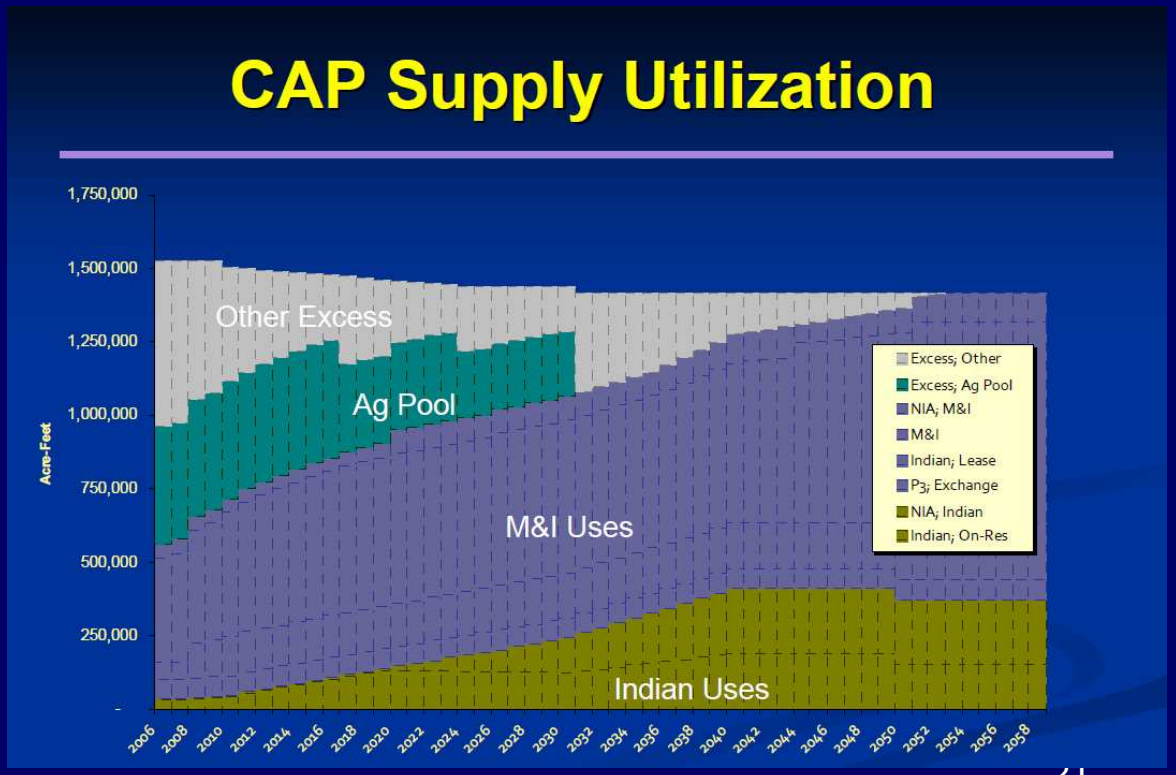
Case Study: NGS & CAP

- 2,250 MW coal-fired power plant
- Water supply: Colorado River (Lake Powell)
- Annual water use: ~26,000 acre-feet (8.5 billion gallons)
- 24.3% of NGS is owned by the Bureau of Reclamation; powers the Central Arizona Project
- Current issue: air quality in the Four Corners region
  - EPA considering different pollution controls

Critical question: How do these pollution controls affect water and water costs in Central Arizona?

Case Study: NGS & CAP

- Central Arizona Project –
  - Provides 1.5 million acre feet (AF) of water to cities, farmers, Tribes, and industrial users in Central Arizona.
  - 336 miles of canal

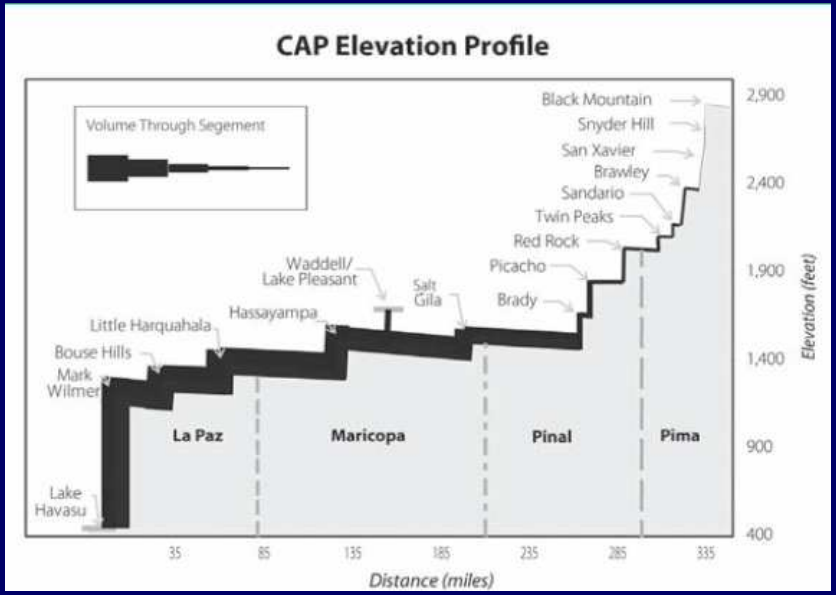


Source: CAP, *www.**cap**-az.com/includes/media/docs/02-24-09-A2E-slides.pdf*

Case Study: NGS & CAP

- Lifts water up 3,000+ feet
- Uses 2,800,000 MWh/yr
- Sells excess capacity from NGS
- Money goes to repaying federal debt, Lower Colorado River Development Fund

- Current issue: regional haze

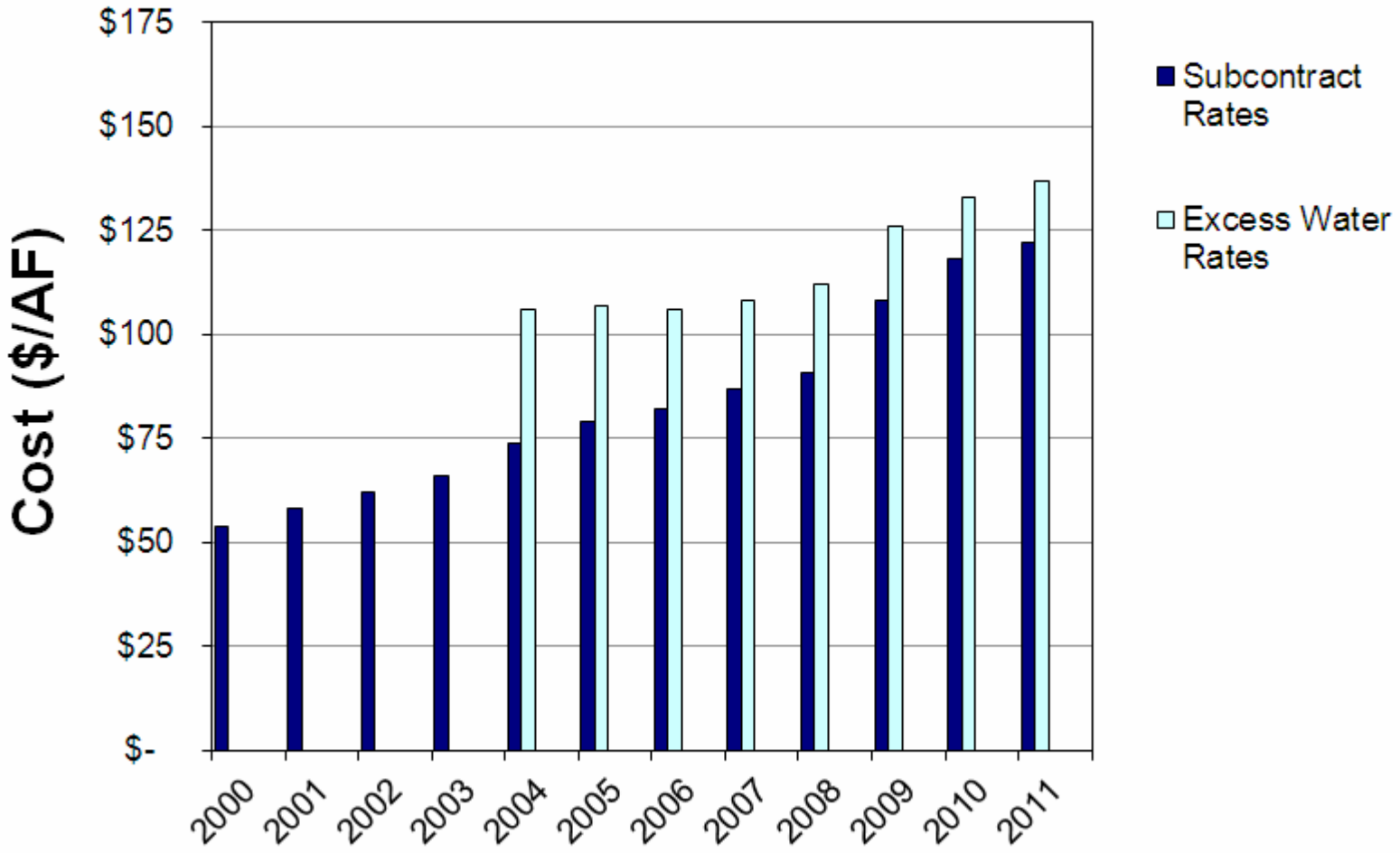


Source: University of Arizona Water Resources Research Center, 2010. *Arroyo*, p. 4, http://ag.arizona.edu/azwater/files/Arroyo_2010.pdf.

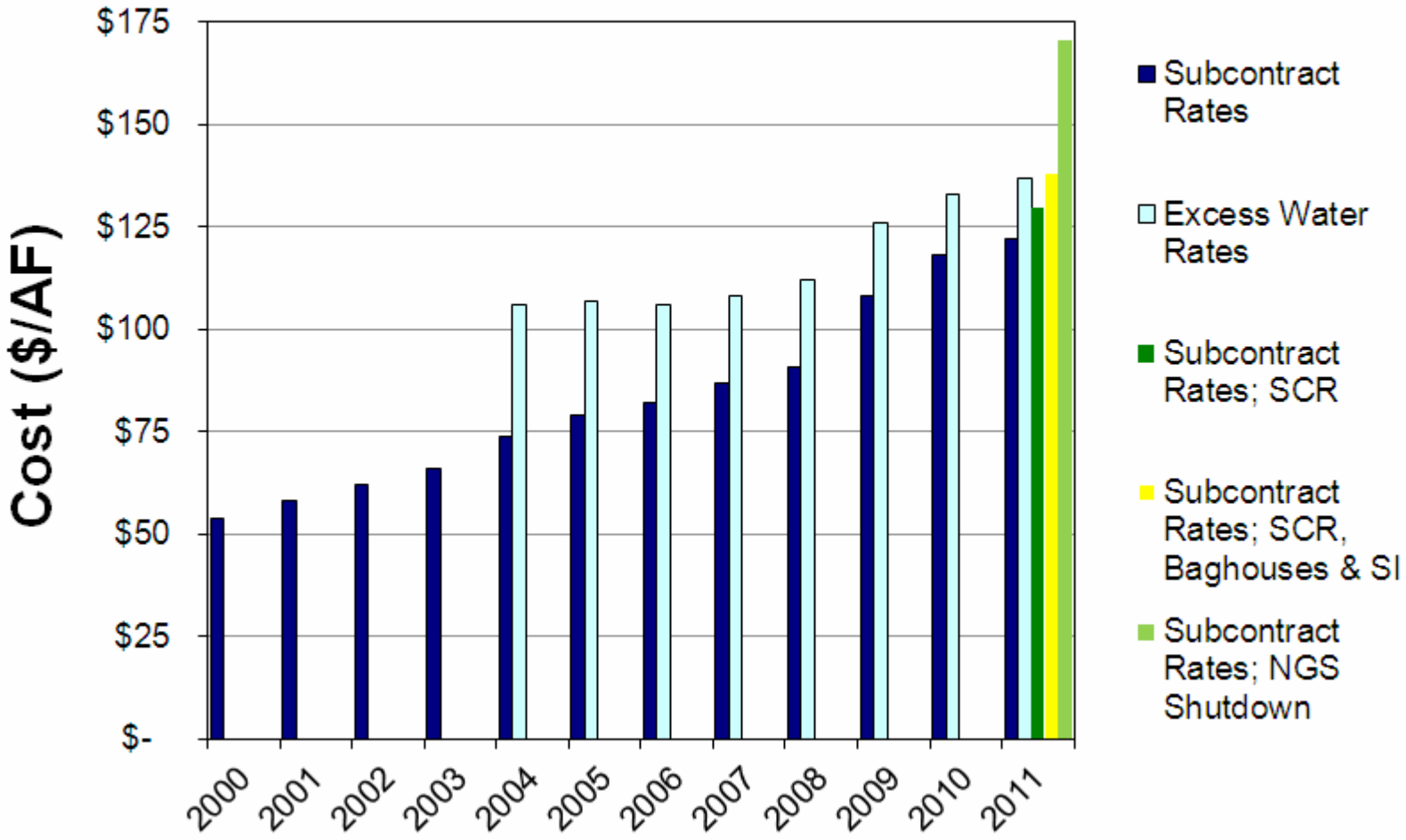
Case Study: NGS & CAP

- Pollution controls/scenarios evaluated by NREL:
  1. Selective Catalytic Reduction (SCR)
  2. SCR with baghouses and sorbent injection
  3. NGS is retired; CAP develops new power supplies

CAP Water Costs



CAP Water Costs



Source: NREL, 2011.

CAP Water Costs

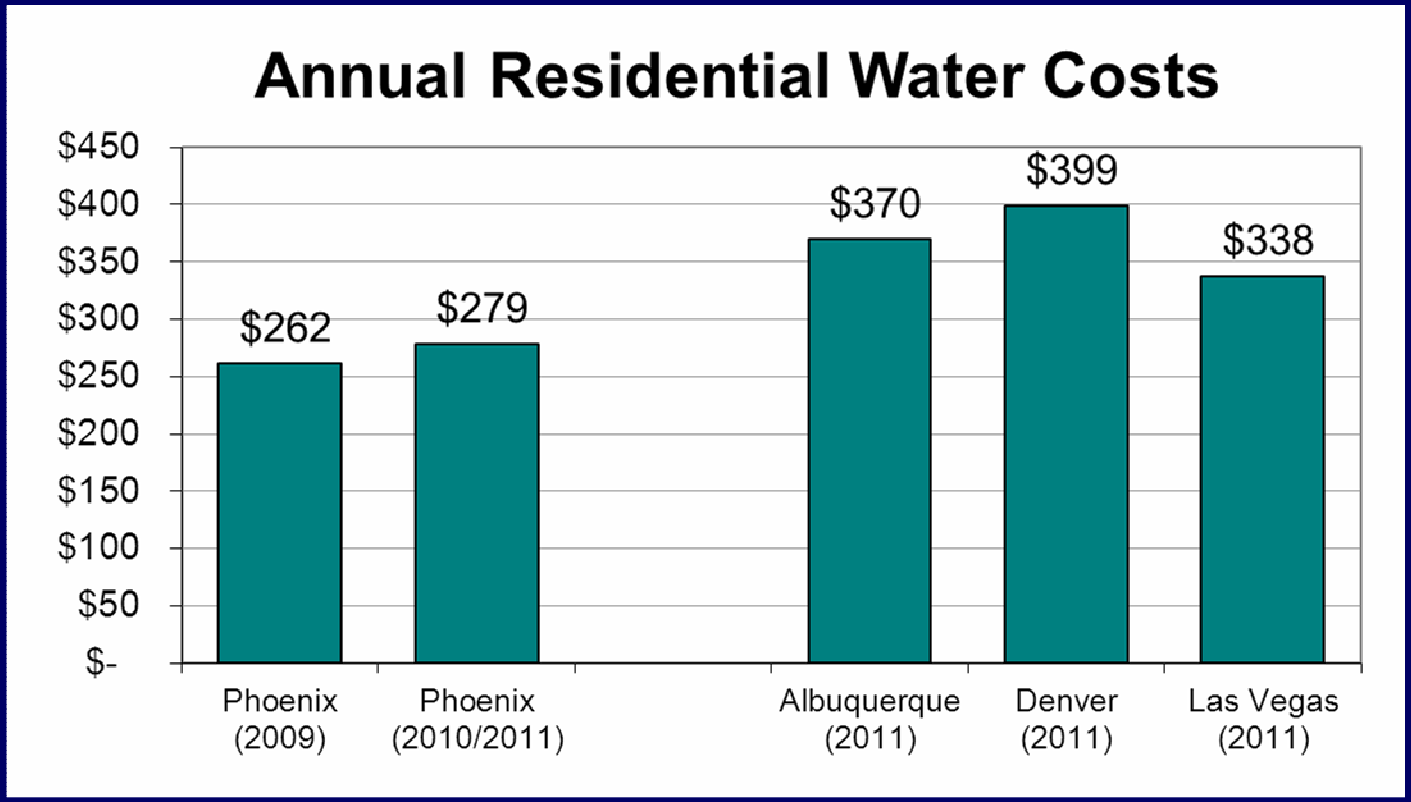
- What do these costs mean for the consumer?

Pollution Control Measure	Monthly Household Cost (Phoenix)
SCR	$ 0.11
SCR, Baghouse, and Sorbent Injection	$ 0.23
NGS Retired	$ 0.67

- Average Phoenix household –
  - Annual water use = 0.37 AF
  - 45% CAP water
- Note: figures reflect average of NREL's high and low cost estimates.

Regional Water Costs

- How do these water costs compare to other cities?



- Figures reflect estimated household costs for the same volume of water (0.37 AF/yr)

NGS & CAP Case Study

- NGS/CAP is an exceptionally complex example of the energy-water nexus
- Clean air does not necessarily mean unaffordable water
  - The most expensive NREL scenario = $0.89/household/month for Phoenix residents
- Alternatives to the pollution control options evaluated may be viable, affordable, and preferable.

Summary

- ✓ Water is a valuable resource – and will likely become more valuable in the future.
- ✓ Arizona is leading the region in integrating water into energy choices.
- ✓ Continued commitment to water-efficient resources and energy efficiency acts as a hedge against the risk of drought.
- ✓ Clean air and affordable water are not mutually exclusive – viable solutions exist.

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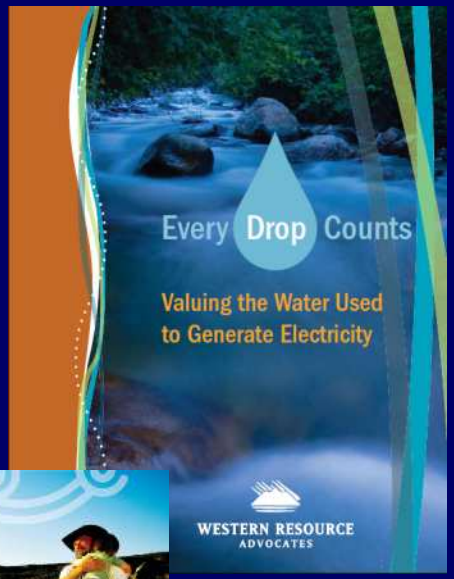

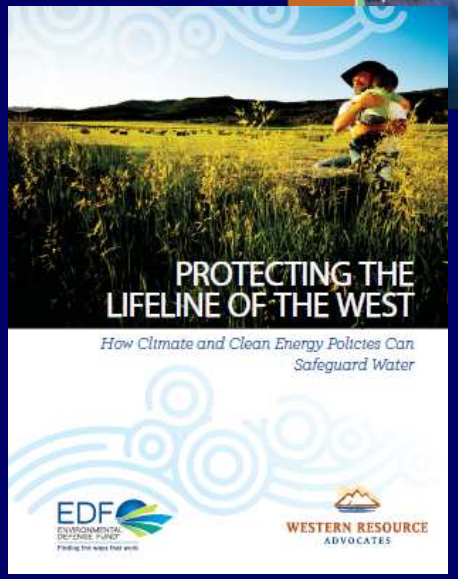

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